all that will remain of its present profusion of plant life will be the specimens in the herbaria of the few collectors interested in city botanizing.

Boston, Massachusetts.

NOTES ON ALGAE. IX.

F. S. Collins.

Gloeocystis scopulorum Hansgirg in Foslie, Contributions to knowledge of the marine algae of Norway, I. East Finmarken. Tromso Museums Aarshefter XIII, p. 155, 1890. This species was described by Hansgirg from material sent him by Foslie, collected in northern Norway; the material was found in clefts of rocks at high water mark and contained a number of minute forms, some of which Hansgirg described as new, while he identified others with already described species. Prof. Foslie has kindly furnished the writer with some of these forms, among them *G. scopulorum*. It forms gelatinous masses of greenish yellow color with cells 4–6 μ in diameter, united in colonies of two to eight cells, with distinctly stratified envelop. At Ragged Island, off Harpswell, Maine, in July, 1908, the writer found in a warm-water pool, above high water mark, among various small green and blue-green algae, an organism agreeing exactly with Foslie's specimen. But it is well known that in stations of this character plants often undergo strange transformations, *Ulothrix*, for instance, assuming Palmella and Gloeocystis forms that no one would connect with the normal form unless by observing the transitions. One can hardly resist the suspicion that *G. scopulorum* is some such stage of a *Ulothrix* or a *Urospora*, which are common in such stations in spring.

Protococcus ovalis Hansgirg, l. c., p. 159, Pl. III, fig. 12. Another doubtful form occurring in similar stations with the last mentioned species. The cells are ovoid or ellipsoid, 8–10 $\mu \times$ 9–12 μ, with thin wall and yellow-green contents, solitary or congregated in a formless, not specially mucilaginous layer. At the Ragged Island locality a form occurred agreeing with this description, and with the specimen from Foslie.

Pilinia endophytica n. sp. For several years the writer has been puzzled by a small green alga, endophytic in *Ralfsia Borneti* Kuckuck, a common *Ralfsia* along the New England coast on live mussels and *Lithothamnion* in tide pools, occasionally occurring on rocks. In July of the present year, while the writer was dredging in Harpswell Sound, Maine, a stone was brought up from about five meters depth at low water, on which was a growth of *Ralfsia*, in which the endophyte occurred rather more abundantly than usual; while the description that can now be made leaves something to be desired, at least it can be put on record and attention called to the plant, so that further investigation can be hoped for. It may be characterized as follows:—

Fronde formae indefinitae, filamentorum plerumque brevium, simplicium vel ramosorum, sistente, inter filamenta plantae hospitis serpentium; cellulis quoad formam et magnitudinem variantibus, cylindricis, clavatis, subsphaericis, vel irregularibus, 7–22 μ diam., 1–5 diam. longis; chromatophora laete virente, cellulam complente, vel plerumque cupuliformi, partem superiorem cellulae occupante. Sporangiis terminalibus, sphaericis vel ovoideis, ad 30 μ diam., sporas numerosas foventibus.

Frond of no definite form, consisting of usually short, simple or branched filaments, creeping among the filaments of the host; cells variable in form and size, cylindrical, clavate, subspherical or irregular, 7–22 μ diam., 1–5 diam. long; chromatophore light green, sometimes filling the cell, more commonly cup-shaped, at the upper end of the cell. Sporangia terminal, spherical or ovoid, up to 30 μ diam., containing numerous spores. In fronds of *Ralfsia Borneti* Kuckuck, Harpswell, Maine, July, 1908. Type in herb. F. S. C.

The placing this species in the genus *Pilinia* might be considered somewhat intuitional, as the vegetative characters are so vague; but imperfect and stunted as the filaments are, their appearance recalls that of undoubted Pilinia species. The occurrence of the terminal sporangium seems to confirm this, but the form must be regarded as greatly modified by the endophytic habit. All distinction between vertical and horizontal filaments is lost, and the cells are very irregular in shape and size; sometimes a filament will be found of six or seven cylindrical or slightly clavate cells, 2–5 diam. long, quite as in typical Pilinia species, but this is unusual. Whether the sporangia produce zoospores or aplanospores could not be determined. The nearest relation of this species would seem to be *P. minor* Hansg. If we may imagine a descent from the latter, from living free on pebbles to living

among the firm and closely packed filaments of the *Ralfsia*, the disappearance of the now useless basal, attaching filaments, and the irregular form of what remains, seem not unnatural. The host is found all along the New England coast from Bridgeport, Connecticut to Cutler, Maine, and whenever it has been examined for the endophyte, the latter has been found.

PRINGSHEIMIA SCUTATA Reinke. When the writer was collecting at Eastham, Massachusetts, Aug. 16, 1908, at "The Salt Pond," really the head of a bay among salt marshes, the Zostera growing there abundantly was found to be the host for many of the smaller species of algae; most of these were familiar and require no comment, but it was of interest to note *P. scutata*, of which only a single record appears for this coast.[1] Here it was not uncommon, and a set for distribution in the Phycotheca was easily obtained. The plant forms minute, rounded, thin, pale green dots on the Zostera, barely perceptible to the naked eye, but easily distinguished by the hand lens.

OCHLOCHAETE FEROX Huber, Ann. Sci. Nat., Series 7, Bot., Vol. XVI, p. 292, 1892. In looking over the material mentioned in the last paragraph, it was noticed that some spots were of a much deeper green color than the others, and microscopic examination showed quite a different structure. In *Pringsheimia* there is originally a thin disk of laterally united radiating filaments, later developing another layer in the middle part of the disk, the cells of this second layer rounded but with no outgrowths. In the other form the frond consists of a densely packed mass of cells, with no indication of radiating filaments; the cells are ovoid or flask-shaped, vertically elongate, and terminate each in a long colorless hair. These characters identify it with *O. ferox*, not before recorded for America. Though not quite as frequent as the *Pringsheimia*, enough was found for distribution in the Phycotheca Boreali-Americana, and both species will appear in Fascicle XXXI.

SPHACELARIA FUSCA C. Ag., Sp. Alg., Vol. II, p. 34, 1828. This species, though dating from so long ago, was always a matter of doubt until Sauvageau,[2] brought forward the characters that distinguish it from the common *S. cirrhosa* (Roth) Ag. The latter species is abundant on the New England coast from Cape Cod south, and is occasionally found, usually in warm, sheltered bays, as far north as the Gulf

[1] Collins, Bull. Torrey Bot. Club, Vol. XVIII, p. 340, 1891.
[2] Sauvageau, Jour. de Bot., Vol. XVI, p. 209, 1902.

of St. Lawrence. June 16, 1907, the writer found on the bay shore of Eastham, Massachusetts, growing on a spider crab, *Libinia canaliculata* Say, what appears to be *S. fusca*. *S. cirrhosa* is a variable species, and as regards most characters it is hard to draw a line between it and *S. fusca*; the most conspicuous character is found in the pro-pagula; in *S. cirrhosa* the three rays are sharply contracted at the base; in *S. fusca* there is no such contraction, the rays being cylindrical or tapering slightly from base to summit.

PETROCELIS MIDDENDORFFII (Rupr.) Kjellman, Algae of the Arctic Sea, p. 140, 1883. The first notice of the occurrence of *Petrocelis* on the New England coast is by Farlow [1] under the name of *P. cruenta* J. Ag.; this name has since been retained in all references to the plant of this region. A comparison with a specimen from Cherbourg, France, collected and determined by Le Jolis, shows so much difference that the two cannot be considered as belonging to the same species. The frond in *Petrocelis* forms an incrustation on rocks at or near low water mark on exposed shores; it is thin but not as thin as the frond of the common *Hildenbrandtia prototypus* Nardo; the latter is more or less translucent, the color being a lighter or darker red according to the color of the substratum. The Petrocelis frond is quite opaque and usually of a duller red. It consists entirely of vertical filaments, in which two parts can be distinguished; a lower layer in which the filaments are firmly united laterally, and an upper layer in which they are in contact, but do not adhere. On the top is a relatively firm cuticle. When the cover glass is pressed down on a bit of the plant under the microscope, it is common for the filaments of the upper part to be held by the basal part below and by the cuticle above, while separating easily between. In the European plant the basal part is only a small portion of the whole thickness, while in the New England plant it is seldom of less thickness in a mature plant than the upper part, and often it is two thirds of the whole thickness. In the European plant the cells of the free filaments are moniliform, 1–2 diam. long, about 8 μ diam. at the base, diminishing to 4 μ at the top. In the American plant the filaments are cylindrical or only slightly tapering, 3–4 μ diam., cells up to 3 diam. long. These characters indicate that our plant is *P. Middendorffii*, a plant probably of circumpolar distribution, as it occurs in Norway, and in the Pacific from Alaska to California.

[1] Farlow, N. E. Marine Algae, p. 115, 1881.

That the distinction has not before been made is not unnatural; our plant does not grow on small or loose stones, it seems to prefer the hardest rock, seldom occurring on soft or crumbling rocks, where it could be easily removed. It cannot be scraped off without reducing it to a shapeless mass, but a knife must be used, and unless special care is taken, the greater portion of the basal part is left on the rock. In material so obtained the difference between the basal part and that of *P. cruenta* is not noticeable. The material distributed in P. B.–A., No. 899, is of this character; it is intended to distribute another lot, of more perfect material, which will show the identity with the *P. Middendorffii* of the west coast, distributed as P. B.–A., No. 900.

The tetraspores of *Petrocelis* are formed by transformation of cells of the upper part; in *P. cruenta* and *P. Middendorffii* one cell in a filament is so transformed, rarely two cells. In *P. Hennedyi* (Harv.) Batters of northern Europe the tetraspores are seriate, often occupying a considerable portion of the filament; this species may occur with us. Unfortunately, spores in *Petrocelis* are rare, except in winter, which is not a pleasant time to collect on exposed shores at low water mark. The writer has examined specimens of *Petrocelis* from Nahant and Magnolia, Massachusetts; from Mount Desert Island, Cutler, several points in Penobscot Bay and several points in Casco Bay, Maine; after allowing for the effect on the basal layer of the manner of collecting, they agree very closely; specimens from Scotland and England agree equally well with Le Jolis' plant. The writer formerly reported *P. cruenta* as occurring in Southern Massachusetts;[1] a re-examination of the specimen shows that it is not a *Petrocelis*; so that as far as our records go, the genus is limited to the region north of Cape Cod.

The marine flora of the New England coast from Cape Cod north is of a typical arctic character, but as is well known, there are exceptional stations where plants characteristic of more southern regions occur; such stations have been recorded at Weymouth and Quincy, Massachusetts,[2] Gloucester, Massachusetts,[3] Penobscot Bay, Maine.[4] At all these stations there is much variation from one year to another, apparently on account of the difference in temperature, etc., in different years. An early spring, followed by a warm summer, will bring an abundant development of characteristic southern forms, while

[1] Bull. Torrey Bot. Club, Vol. X, p. 56, 1883.
[2] Collins, Bull. Torrey Bot. Club, Vol. X, p. 29, 1884.
[3] Farlow, N. E. Marine Algae, p. 6, 1881.
[4] Collins, Rhodora, Vol. I, p. 69, 1899.

in a year in which the spring is late and the summer not warmer than the average few or none may appear. The past summer would seem to have been an ideal one for these plants, the excess of temperature above the normal for the year being about 400° at Boston on the first of August. The writer had an opportunity in July to observe two stations, not previously recorded in this respect, and the following notes may have some interest.

Along the New England coast as far north as Portland, Maine, salt marshes form quite a considerable portion of the shore, but beyond Portland they are less common. At Stover's Point in South Harpswell is a small salt marsh, separated from Harpswell Sound by a ridge of stones and gravel, through which there is a quite narrow and shallow opening. Except at spring tides the change of level in the numerous shallow pools of various size that are scattered through the marsh is slight, and the greater part of the water remains from one tide to another. In the hot days of last July the water in these pools was almost unpleasantly warm to the hand. The felty mass of algae, usual in such places, covered the smaller pools, and much of the surface of the larger pools. The composition of this mass was the common warm water combination, *Cladophora expansa* (Mert.) Kütz., *Rhizoclonium riparium* (Roth) Harv., *Lyngbya aestuarii* (Mert.) Liebm., *L. confervoides* Ag., *Enteromorpha intestinalis* (L.) Link, *E. crinita* (Roth) J. Ag., *E. Hopkirkii* McCalla, *Ilea fulvescens* (Ag.) J. Ag., and in less quantity *Pleurocapsa fuliginosa* Hauck, *Calothrix confervicola* (Dillw.) Ag., *C. scopulorum* (Web. & Mohr) Ag., *C. aerugínea* (Kütz.) Thuret. *Palmellococcus marinus* Collins, described from material collected here in 1906, was present this year, but in less quantity; and there was considerable of two blue-green algae, usually found only in fresh water, *Nostoc sphaericum* Vauch. and *Gomphosphaeria aponina* Kütz.

In the largest pool were floating many fragments of algae, naturally growing in exposed places, the same as are found washed up all along the shore; but in this warm water they had assumed a quite different appearance. *Chondrus crispus* (L.) Stack. was abundant, and the fronds had continued to grow with a luxuriance quite unknown before; fronds two or three dm. long were not uncommon, broad and richly branched, often with proliferous growths; the color pale red or yellow; evidently the environment was much to their liking. Common also were floating fronds of *Ahnfeltia plicata* (Turn.) Fries, but all were

dead; the normally dark and shining wiry fronds were a brownish yellow, and their surface was variegated with "collars" of *Ralfsia verrucosa* Aresch. The *Ahnfeltia* is common all along the Maine coast, as is also the *Ralfsia*, but the latter has never been observed to grow on the former under normal conditions. Luxuriant coatings of *Ralfsia* were found on the dead or dying floating fronds of *Fucus vesiculosus* L., *F. evansecens* Ag., and *Ascophyllum nodosum* (L.) Le Jolis. The *Ralfsia* formed a continuous coating on practically the whole surface of these fronds, though never occurring on them in their natural habitat, whether attached or floating.

The other locality noticed was at Ragged Island, about five miles off the Maine shore, between Cape Elizabeth and Cape Small Point. The island is about half a mile in diameter, the coast entirely rock cliff, often rising perpendicularly for some height. On the south side there are perpendicular rocks of this character, the top considerably above even the spring tides. From some peculiarity of this rock, there is a series of rather large and deep pools just back from the edge; into these pools a certain amount of fresh water drains from the neighboring part of the island, but the supply must be small; apart from this, and whatever rain falls into the pools, the only supply is from the surf breaking over the wall. During a gale this supply must be continuous, but in ordinary weather it is cut off. It is evident that a great range in temperature and salinity is possible here. If we suppose the pools filled by a storm, and then a long period of quiet weather without rain, the salinity must steadily increase. A rainfall would somewhat diminish it, but only a very heavy rain, sufficient to fill the pools and run over, could bring the salinity below that of the surrounding sea. The salinity would be higher than normal until a severe storm should throw in water enough to fill the pools several times over, practically replacing the contents with normal salt water. Whenever the pools were so filled, the temperature would be that of the sea, which here is very cool, even at midsummer, while in winter they would be undoubtedly frozen, and a few hot calm days in summer would bring them to a temperature reached by the sea only in the tropics. The list of permanent tenants of such a pool would be reduced to forms capable of enduring very salt water as well as the ordinary salinity, and both tropical and arctic temperatures. On the other hand, plants developing very quickly under favorable conditions, forming at once spores that will carry them through unfavorable condi-

tions, would delight in such a station, where there would be few or no all-the-year natives to compete with these summer visitors to the Maine coast.

On July 13, 1908, there was here an immense quantity of individuals, though not very many species; most of them were blue greens; *Polycystis elabens* Kütz., *Entophysalis granulosa* Kütz., *Gloeocapsa crepidinum* Thuret, *Oscillatoria tenuis* Ag., *Spirulina subsalsa* Oersted, *S. Meneghiniana* Zan., *Lyngbya aestuarii* (Mert.) Liebm., *L. semiplena* (Ag.) J. Ag., *L. subtilis* Holden, *Plectonema Battersii* Gom., *P. calothrichoides* Gom., *Anabaena torulosa* (Carm.) Lagerh., *Nodularia Harveyana* (Thwaites) Thuret, *N. spumigena* Mert., *Calothrix scopulorum* (Web. & Mohr.) Ag., *Amphithrix violacea* (Kütz.) Born. & Flah., and some forms of *Chroococcus* and *Plectonema* that have not been specifically determined. The green algae were *Enteromorpha intestinalis* (L.) Link, *E. Hopkirkii* McCalla, *E. crinita* (Roth.) J. Ag., *Cladophora expansa* (Mert.) Kütz., *Ilea fulvescens* (Ag.) J. Ag., and *Urococcus Foslieanus* Hansg. The *Entophysalis* was chiefly attached to the rocks; the *Calothrix* and *Amphithrix* to *Enteromorpha* and *Cladophora*; all the others were free and mingled in all proportions; sometimes in loose masses on the bottom, sometimes in rather denser masses at the surface; the color varying according to the proportion of the different species and to the exposure to light; the strata at the bottom, sheltered from the light, were mostly dark green or olive; those at the surface pale green, yellowish or almost white. The quantity was astonishing; at least half the surface was covered by the mats, and very little of the bottom could be seen. When we remember than an individual of *Polycystis* is about 3 μ diameter, about one ten-thousandth of an inch, while a filament of *Spirulina* is considerably less, the number of individuals in these pools, with a surface of perhaps an acre and a depth of several feet, would reach a figure with no real meaning to us. And there is no doubt that the entire quantity had developed since the beginning of the warm weather. The winter storms must sweep the pools clear of all such vegetation, except stray spores or resting cells in crevices or under ice.

The writer visited this station in 1903 and in 1906, each season in July, and the conditions were then much the same, but in 1908 the growth was considerably more luxuriant than before, and the level of the water decidedly lower, which of course meant increased salinity. The effect of the latter condition was seen in some abnormal appear-

ances in the Enteromorphas, which are most at home in ordinary sea water; in an increase in the Spirulinas, which are specially plants of lagoons and drying-up pools. Possibly these conditions may have induced the development of *Gloeocystis scopulorum*, mentioned earlier in this paper, from some Ulothrix which was here earlier in the season, but could not maintain its normal form under the summer conditions.

One species remains to be mentioned; *Chaetomorpha aerea* (Dillw.) Kütz. This is usually spoken of as a common species on the New England coast, and if we include under the name the free-floating form known as *C. Linum* (Fl. Dan.) Kütz., just as what has been known as *C. Picquotiana* (Mont.) Kütz. is now considered a free form of *C. Melagonium* (Web. & Mohr) Kütz., this opinion is undoubtedly correct; the *C. Linum* form abounds from Long Island Sound to Passamaquoddy Bay. But as to the attached plant, *C. aerea* in the older sense, the case is different. South of Cape Cod it is not uncommon and grows at low water mark and some distance above and below; but in 30 years collecting the writer has only twice found it north of Cape Cod, and in each case it was in a rock pool, at extreme high water mark; once at Cohasset, once at Marblehead, in both cases in small quantity. Here at the Ragged Island pools there was a dense growth around most of the edge, just below the water line; as densely packed as the grass in a lawn. The filaments were all quite short, and there was a white band of dead fronds, above the water level, considerably broader than that of living fronds below the level; evidently the environment had been exceptionally favorable to the species earlier in the season. In 1903 and 1906 nothing was seen of this species, and if we suppose that it is distinct from the floating *C. Linum*, it would be hard to account for its sudden appearance in such quantity; the currents here tend southerly, and the chance of a frond or a spore being brought from southern New England and thrown up by the waves into the pool would be very small. Even if this were possible, there must have been several generations of plants in a very short time to produce this dense growth for such a distance. But if we suppose that it arose from the floating form, which is abundant in the vicinity, the spores finding favorable conditions, similar to those of warmer regions, all is clear.

To sum up as regards these two stations:— even on shores where conditions are subarctic, individual stations may be found where the conditions for a short time are almost subtropical; in such stations the

number of species must be limited, but the number of individuals developed in a short time may be enormous; they will be mostly plants of very rapid development and of short life, and mostly of quite low organization; some plants, common in the subarctic waters may here assume a sudden luxuriance (*Chondrus*); some may also appear on a different substratum (*Ralfsia*); some may take on a habit so distinct as to be considered a separate species native to lower latitudes (*Chaetomorpha*).

MALDEN, MASSACHUSETTS.

A TRIP TO KILLINGLY, CONNECTICUT.

CLARENCE H. KNOWLTON.

AFTER considering several other places for a one-day botanical excursion, Mr. L. J. Spalding and I finally decided on Killingly, Windham county, Conn. We were led to this by a study of the map, which revealed a diversified region ranging in elevation from 280 to 875 feet above sea-level, with brooks, ponds and hills. A previous reconnoissance in July, 1903, had shown us that the underlying rocks were sandstone and quartzite. We had also noted and collected several interesting plants at that time.

The day chosen (Aug. 23, 1908) was clear and cool after heavy rainfall, the vegetation was fresh, and walking easy. We left the cars at Attawaugan, and the first plant collected was *Commelina communis* L. It grew luxuriantly in the woods near Five-Mile River, on a bank which had been used as a dump at some time previous. The delicate blue flowers were still open, and the plant seemed to flourish in its adopted home.

The next accession grew abundantly in the millyard and by the roadside at Ballouville. This was *Euphorbia hirsuta* Wiegand, easily distinguishable from its nearest relative by its hairy stem, smooth fruit and peculiar seed. These specimens were not so nearly prostrate as *E. maculata* L. usually is.

We now left the villages and explored a large meadow, part of which had been mowed. In this part grew good specimens of *Parnassia Caroliniana* Michx., just coming into flower. In the uncut portion, along with many common plants, were *Pycnanthemum linifolium*,